

**Hawaiian Electric Company, Inc.
Hawaii Electric Light Company, Inc.
Maui Electric Company, Ltd.**

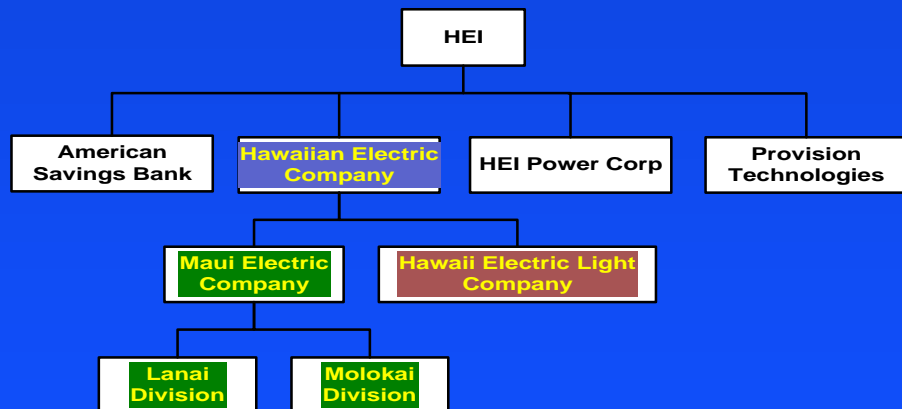
Renewable Energy Activities at HECO, HELCO & MECO

**Opportunities for Renewables & Utility
Project Financing Workshop
April 2-3, 2001**

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1

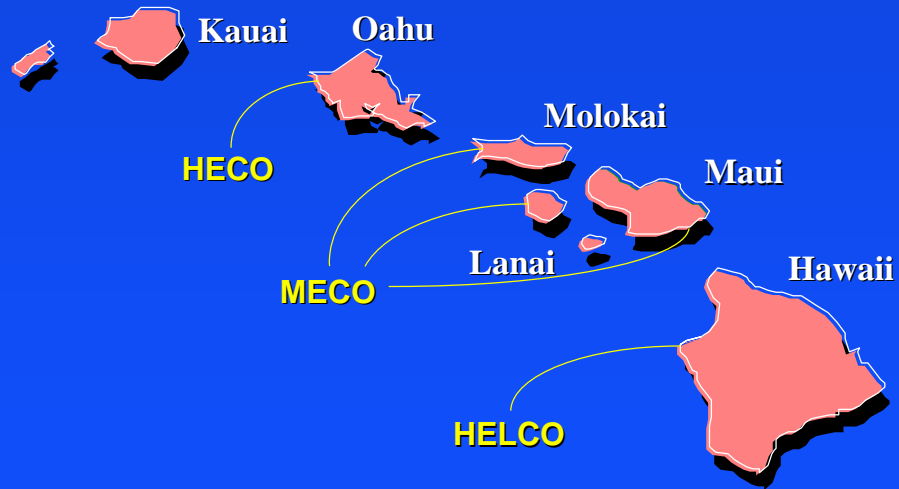
Hawaiian Electric Industries, Inc.



Hawaiian Electric Company

2

Hawaiian Electric Company Utilities



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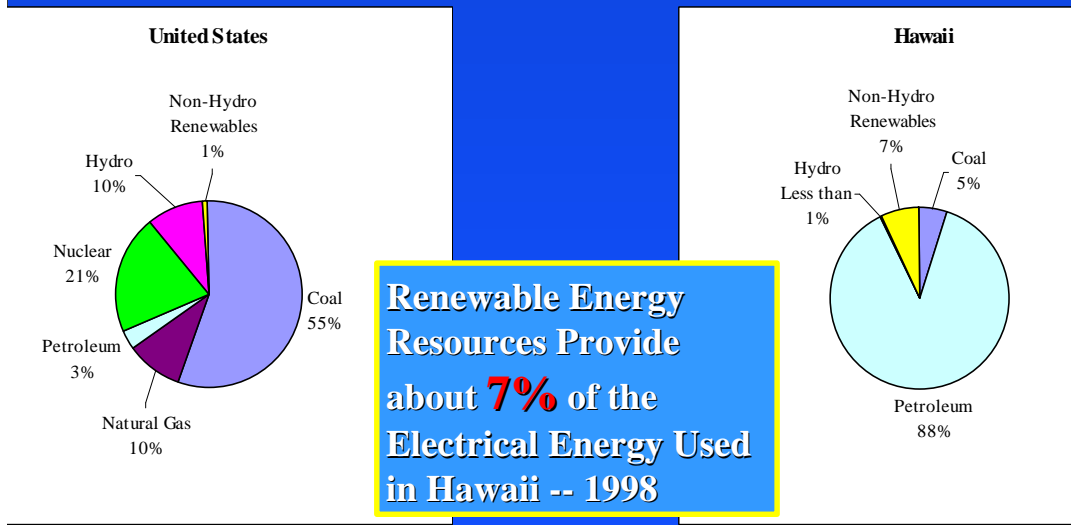
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What is HECO's Position on Renewable Energy?

- **The Hawaiian Electric utilities strongly encourage and support the goal of actual implementation of reliable, sustainable, cost-effective renewable energy resources.**

Source: Renewable Energy Docket No. 94-0226, page E-31

How Much Electricity Does Hawaii Get From Renewable Energy Resources?



In Hawaii, renewable energy provides about 7% of the electricity used in Hawaii . We have a variety of sources such as:

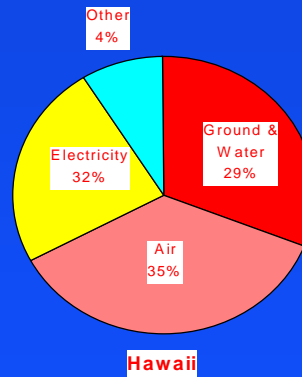
- geothermal
- garbage-to-energy
- biomass from sugar cane
- wind, and
- hydroelectric sources

Although our renewable energy percentage is slightly lower as compared to the rest of the country, our diversity is greater because a big portion of the renewable energy on the mainland comes from large hydroelectric dams.

What is Hawaii's Petroleum Consumption by Sector?

32% of the Imported Oil is
Used for Electrical Generation

64% of the Imported Oil is
Used for Transportation -- 1998



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6

Here's another statistic to help put Hawaii's use of oil into perspective.

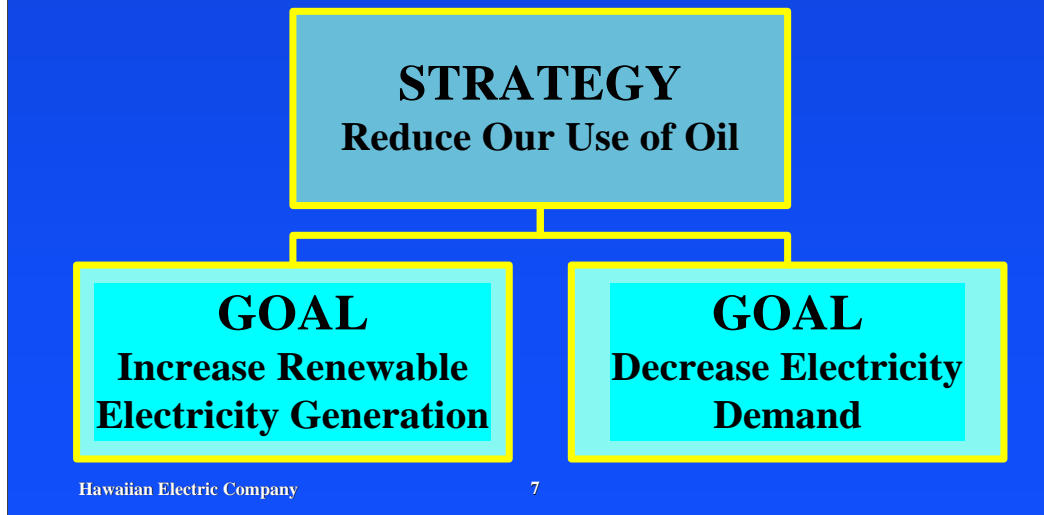
**Only 32% of the oil we import is used for electrical generation.
64% is used for transportation.**

<<Show tar in a bottle>>

So even if we reduce our dependence on oil in the electric industry, we still have a long ways to go with transportation.

Having said that, we remain committed to supporting reliable, sustainable, cost-effective renewable energy sources for our islands.

What is HECO's Plan to Reduce Oil Use?



We've supported the development of renewable energy and programs encouraging more efficient use of energy. One way to get more credit for these efforts is to link them under an OVERALL strategy...which is...to reduce Hawaii's consumption of imported oil.

Again, we can accomplish this in two ways:

First by INCREASING the amount of electricity we generate from renewable sources and

Second by DECREASING electricity demand.

If we're successful in doing this, we can establish ourselves as leaders in supporting renewable energy in Hawaii and decreasing the state's use of imported oil.

What has HECO, HELCO and MECO done to Support Renewable Energy in the past?

- HERS wind farms
 - Kahuku
 - Lalamilo
 - Kahua Ranch
- Molokai wind
- Kahuku wind
- Kapalua wind
- Maalaea wind
 - Windane
- Geothermal HGP-A operation
- Geothermal RFP
- Hawaii deep water cable program
- Molokai biomass
- OTEC
 - Kahe
 - NELHA

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8

HECO Utilities have been part of many different renewable energy projects, studies and commercial ventures.

The listing above presents just a few of these work efforts in renewable energy.

What are HECO, HELCO and MECO Doing to Support Renewable Energy?

- Provide **115 megawatts** of renewable energy from various sources
- Recently signed purchase power agreement to buy additional **10 MW of wind power at Kahua (Big Island)** and **3 MW of wind power at Hawi (Big Island)** and agreed on price for a **20 MW wind farm at Kaheawa (Maui)**
- Implemented a **Green Pricing Tariff**
- Administers the **largest solar water heating program in the country**
- Participate in **research and development projects** with Federal and State agencies and other groups

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9

So what is the HECO family doing to support renewable energy?

- **We provide 115 MW of power from renewable resources.**
- **We recently signed a purchase power agreement with Zond for 10 MW of wind energy on the Big Island.**
- **We implemented a Green Pricing Tariff where customers can make voluntary contributions through their electric bills to support renewable energy.**
- **We have the largest solar water heating program in the country and**
- **We're partnering with the Federal and State governments in research and development projects.**

46 MW Garbage-to-Energy Power Plant on the HECO System (since 1989)



HPOWER

Oahu

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10

First, let's talk about some of the major sources of renewable energy we have on our system.

Here on Oahu, HECO purchases 46 megawatts of electricity from the City's Garbage-to-Energy HPower plant.

This is one of three sources of firm, base-load power, the others being geothermal and bagasse.

Remember this is a get rid of waste project--electrical production is a by-product. The resource is limited to where the population center resides and thus produces more garbage. The HPOWER facility has seen a decline in their feedstock (waste) over the last 7 years.

3 MW Landfill Gas Facility on the HECO System (since 1990)



Methane Gas plant at Kapaa Landfill

Kailua, Oahu

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11

HECO also buys about 3 MW of intermittent energy from a methane gas-to-energy plant located at the Kapaa landfill in windward Oahu.

Landfill are limited in Hawaii, thus the resource potential is small.

30 MW Geothermal Power Plant on the HELCO System



Puna Geothermal Venture

Big Island

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12

On the Big Island, HELCO purchases 30 megawatts of geothermal energy from Puna Geothermal Ventures. This is the second source of firm, baseload power.

Because of this large geothermal source, renewable energy provides a whopping 29% of the Big Island's electricity.

This is much more than the often praised State of California.

11 MW of Wind Farms on the HELCO System (since 1985)



Lalamilo windfarm

Big Island

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13

Commercial wind farm operations have been in place in Hawaii since 1985.

HECO was part of first major wind farm testing in the early 1980s with the MOD-OA testing at Kahuku. This eventually lead to a commercial wind farm at Kahuku--12 MW. Unfortunately, this wind farm was shut down for financial reasons.

MECO tested a wind turbine in the early 1980s.

Only the Lalamilo and Kamaoa (now Apollo) wind farms on the Big Island are operational. HELCO has about 11 MW of wind energy in its system. It buys about 7 MW from the Apollo Windfarm in Kau and 2 MW from a number of smaller installations. HELCO also owns a 2 MW facility at Lalamilo.

The one big disadvantage with wind is that, because it's an intermittent source, it is not available 24 hours per day.

Shown here is the HELCO Lalamilo Windfarm.

33 MW Future Wind Farms on the HELCO and MECO Systems



Zond Iowa Wind Farm

- Big Island (Kahua)
 - 10 MW using Zond 750 kW wind turbines
- Big Island (Hawi)
 - 3 MW using Vestas 660 kW wind turbines
- Maui (Kaheawa)
 - 20 MW using Zond 750 kW wind turbines
- Interconnection studies are being conducted

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14

In that past there has been other wind developments in Hawaii. However, they were never fully developed for various reasons.

In 1985, MECO had a wind power purchase agreement approved by the PUC--the contract was eventually terminated in 1989 since the wind developer could not get the land for his project.

In 1991, MECO entered a power purchase contract for a 1 MW wind farm on Molokai--the wind turbines failed in 1994 and were never repaired--the contract was finally terminated in 1997.

In 1992, HECO entered a power purchase agreement with a wind developer at Kahuku--the PUC approved the agreement; however, at lower cost--thus, the wind developer decided not to pursue the project.

HELCO recently signed a power purchase agreement with Zond Pacific for a new 10 MW wind farm on the Big Island to be operational in 2001.

This slide shows the 750 kilowatt Zond wind turbines that will be installed in Hawaii.

This wind contract with Zond demonstrates that we ARE willing to buy renewable energy *when the price is fair and reasonable for our customers.*

19 MW of Hydroelectric Plants on the HELCO and MECO Systems (since 1900s)



Waiau hydroelectric plant

Big Island

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15

On the Big Island, HELCO owns and operates two hydroelectric facilities at Waiau and Puueo with a total capacity of 3 MW. Installed in the early 1900s, these generating units have a long life.

HELCO recently refurbished the penstocks for these hydro units that will extend their usefulness to the utility.

HELCO also purchases 10 MW of energy from Wailuku Hydroelectric's facility, and

MECO purchases 6 megawatts of energy from Hawaiian Commercial and Sugar Co.'s three hydroelectric facilities.

Most of the sugar mill hydroelectric units have been operational since the early 1900s.

12 MW Bagasse-Fired Facility on the MECO System (since 1985)



Biomass (bagasse)

Maui

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16

Also on Maui, Hawaiian Commercial and Sugar Co. uses bagasse, or the residue from sugar cane processing, and provides 12 megawatts of firm power to the MECO system. This is the third source of firm power.

In recent years, when the sugar mills closed its operations on the Big Island (5), Maui (1), Oahu (2) and Kauai (1), all biomass power generating facilities on this island ceased also. Detailed evaluations have been made for a dedicated biomass to electricity operation at island sugar mill sites; however, the results have shown it is not cost-effective to pursue. In fact, there is no dedicated biomass to electricity operation in the United States—all existing biomass power operations use biomass wastes.

In 1988, MECO purchased biomass generated power from a Molokai biomass operation. The facility was shutdown in 1990 due to the lack of biomass fuel.

Green Pricing Program *Sun Power for Schools*



We have also promoted partnership opportunities when it comes to adding more renewable energy on our system.

In 1996, we implemented a Green Pricing Program to allow customers to make voluntary contribution through their electric bills to build renewable energy projects.

To demonstrate our commitment to the Green Pricing Program, we have started the Sun Power for Schools program where we install 1 kilowatt or 2 kilowatt photovoltaic systems at schools throughout the State. Because customer contributions are not enough to fully pay for these systems, we have subsidized the program at a cost of \$140,000.

Just to give you a feel for the cost of PV systems, the 2 kW PV systems we've installed at various schools on Oahu cost us about \$20,000, or \$10,000 per kilowatt.

Although the capacity of these photovoltaic systems is small, the biggest benefit we're getting from these installations is that the high school teachers are using them as educational tools for their renewable energy classes.

Green Pricing Program

Customer Participation as of 12/31/00

• HECO	1,306 Participants (0.56%)
• HELCO	312 Participants (0.60%)
• MECO	338 Participants (0.73%)
• Total	2,036 Participants (0.59%)

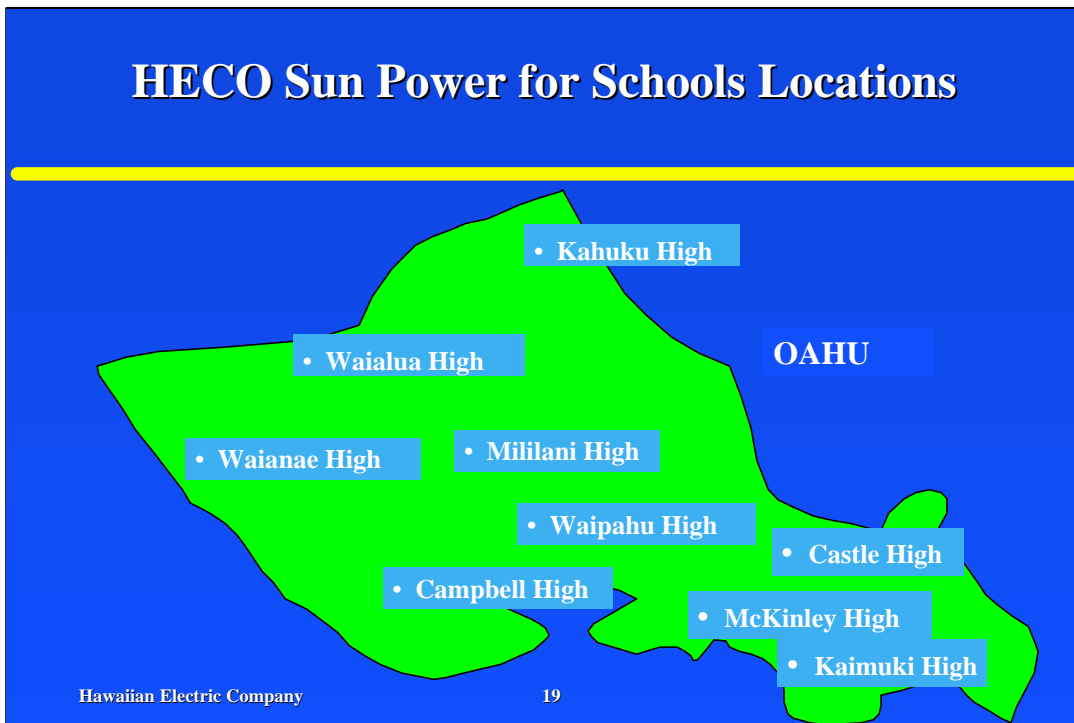
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18

Although previous surveys showed that between 30% and 50% of our customers were willing to contribute to renewable energy, less than 1% of our customers are actually making voluntary contributions. Since the inception of the program contributions have totaled over \$169,000.

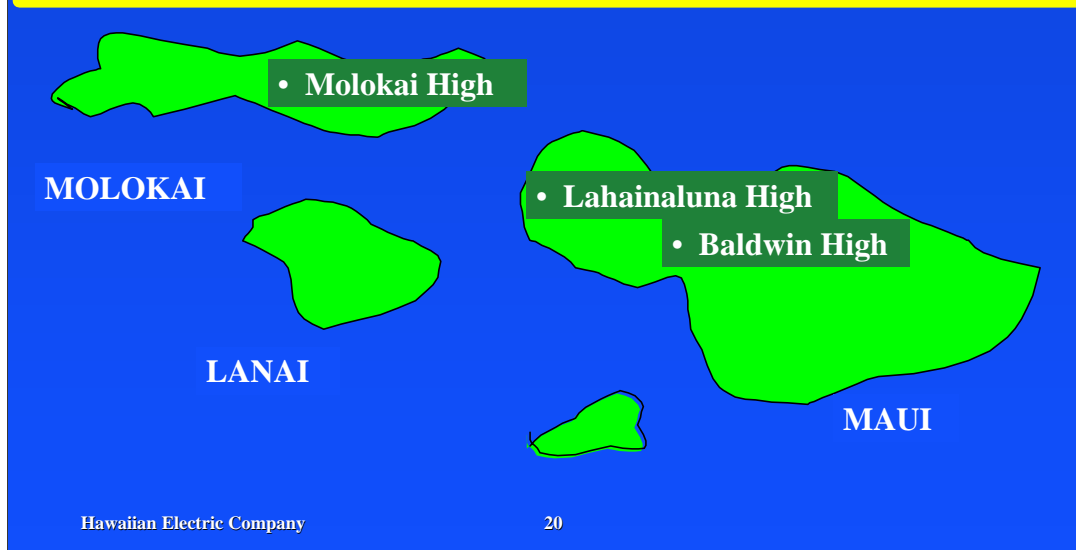
This percentage is the norm for other green pricing programs on the mainland.

HECO Sun Power for Schools Locations



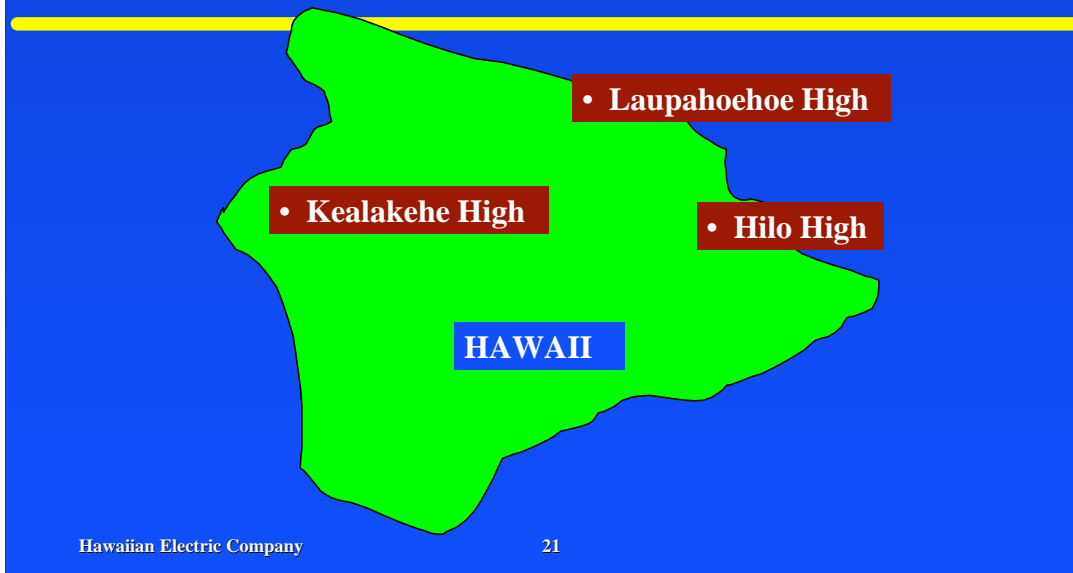
These are the high schools on Oahu where we've installed 2 kW PV systems

MECO Sun Power for Schools Locations



We have two PV facilities at MECO--the third is being designed--a PV area lighting project at Lahainaluna High School.

HELCO Sun Power for Schools Locations



The installations on the Big Island are 1 kW systems.

Research and Development Support

- **Renewable energy research & development projects with the Federal and State government**
 - MOD-OA Wind turbine at Kahuku, Oahu
 - HGP-A geothermal power plant in Puna, Hawaii
 - OTEC study at Kahe power plant, Oahu
 - Biomass feasibility studies on Maui and Hawaii
 - Hawaii deep water cable program
 - Pumped storage hydroelectric studies
- **Photovoltaic projects**

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22

Over the years, the HECO family has supported a number of research and development projects involving wind, geothermal, OTEC, biomass and photovoltaics as shown here.

The objective of these projects are:

One, to bring down the cost of renewable sources over time and make them more affordable.

Two, to pave the way for full-fledged projects such as the Big Island's geothermal facility, and

Three, to increase our knowledge and experience with specific renewable technologies.

20 kW Grid-Connected PV Demonstration in Kihei, Maui (PVUSA) *Maui High Tech Park (since 1989)*



**A Partnership with Energy Conversion Devices, Dept of Energy,
State, Maui High Tech Park**

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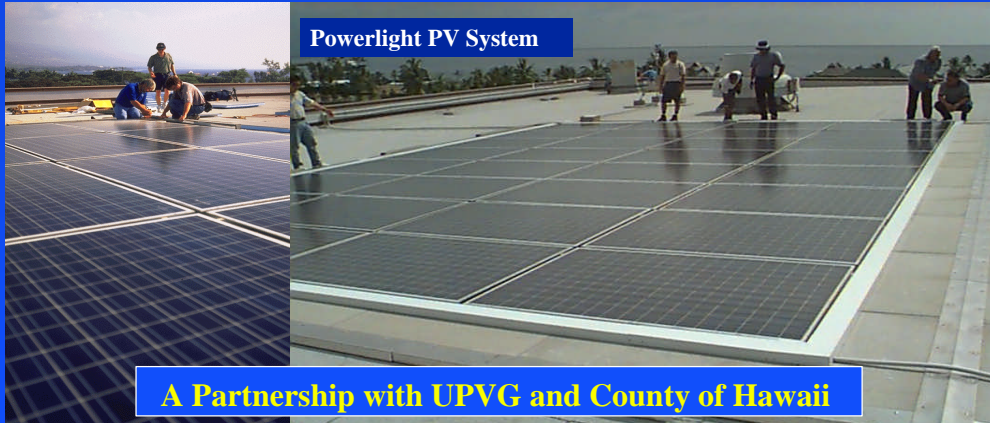
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Let me quickly review some of the PV projects we've been involved in:

This is a 20-kW PV project in Kihei, Maui which MECO has operated and maintained since 1989.

In 1997, MECO replaced the failed inverter with 3 off-the-shelf inverters.

15 kW Grid-Connected PV Demonstration in Kona, Hawaii (UPVG) *Kona Gymnasium (since 1995)*



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24

A 15 kW PV project at the Kona Gym on the Big Island, owned by HELCO feeds solar generated electricity to the Kona grid.

18 kW Grid-Connected PV Demonstration at Hickam AFB, Oahu (EPA) *Autocraft Shop (since 1996)*



**A Partnership with EPA,
EPRI and Hickam AFB**

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And an 18 kW PV system at Hickam AFB.

2 kW Grid-Connected Building Integrated PV at Ford Island, Pearl Harbor

Pearl Harbor Boathouse (since 1999)



A Partnership with UH School of Architecture, NREL and Navy

One of most recent and interesting PV projects...installed this year using Building Integrated Photovoltaics -- incorporates PV systems into the components of the building. In this case, the PV system is an integral part of the roof on the Ford Island Boathouse.

10 kW Grid-Connected PV Demonstration at Kihei, Maui

Whale Sanctuary (since 2000)

A
Partnership
with Dept. of
Energy,
NOAA
Whale
Sanctuary
and
Upcountry
Electric



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27

Off-Grid PV Demonstration Big Island (since 1997)



Although the cost of PV systems may still be on the high side, there are specialized applications of PV that may be the only solution in remote locations.

Our parent company, HEI, recently formed a new company, ProVision Technologies, which will be working in the off-grid PV market.

Off-Grid PV Demonstration Area Lighting (since 1997)

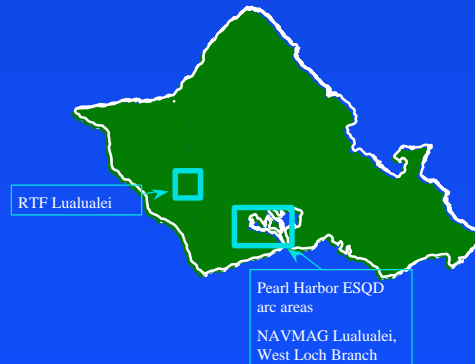


HELCO has also spearheaded efforts to pursue specialized applications of PV such as this area lighting system at the Kona baseyard and at the Honaunau Boat Ramp.

HECO installed a PV area lighting system at our Makakilo substation.

Photovoltaic Siting Assessment

- High cost of land and potential land use conflicts are barriers in Hawaii for PV development
- Locating PV on rooftops, non-developable lands, or an “overlay use” may enable cost effective installations
- DOD lands are candidates for long term “overlay use” for PV power plants



A Partnership with Navy

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30

As part of the HECO--Dept of Defense Energy Partnership--one of the objectives is to investigate future opportunities for the cost effective installation of emissionless technologies.

Thus, HECO and Navy conducted a site assessment on a large PV facility on Navy property.

DBEDT identified Lualualei and West Loch sites for potential PV plants. These sites are not feasible, but others sites in the area were.

In summary the PV facility was too expensive--30-40 cents/kwh.

HECO pursued a subsidized demonstration project using a phased approach--however, government funds were not available.

What is HECO Doing to Increase the Use of Renewable Energy in Hawaii?

In November 1995, PUC Renewable Energy Docket 94-0226, HECO Utilities set forth a *Renewable Energy Action Plan* which incorporates:

- Continuation of “in progress” programs and activities
- New initiatives developed as a result of this docket

HECO's Renewable Energy Action Plan November 1995

- 1. Participate in and monitor on-going research, development and demonstration (RD&D) projects in RE**
- 2. Develop and implement RD&D projects in RE**
- 3. Implement energy efficiency programs**
- 4. Examine "green pricing" feasibility**
- 5. Consider beneficial impacts of renewable energy in HECO's long-term energy planning**
- 6. Facilitate cost effective renewable energy projects**
- 7. Streamline and simplify permitting process for renewables**

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32

These 7 action points were identified by the HECO Utilities as activities the utilities could do to help renewable development in Hawaii.

The action items will be discussed in the following slides.

Special Considerations for Using Renewable Energy in Hawaii

- **Hawaiian utilities are different from mainland utilities**
 - Relatively small utility systems
 - No grid interconnections
 - Reliability is critical
 - » Most renewables are not dispatchable and are not continuously available (solar, wind, hydroelectric)
 - » System capacity needs are met only by dispatchable generation
 - » Dispatchable renewable generation includes geothermal, garbage-to-energy, biomass

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33

Hawaiian utilities are not like mainland utilities, which are large and connected to a large utility grid. If a utility is having problems with power in other states, they can always get the remaining power from other neighboring states. Hawaii is relatively small and not grid connected. We do not have undersea transmission lines that can connect all the islands. Thus, reliability is an important factor in utility planning.

Renewable Energy Challenges

- Dispatchable power vs. intermittent
- System penetration considerations
 - Performance standard curtailment
- Capital costs are relatively high
- Various stages of technical development or maturity
- Large land requirements
- Viability is site specific
- Potential environmental impacts

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34

Over 25 years of renewable energy experience gained in Hawaii through research, development, demonstration activities have led to over 115 megawatts and a large knowledge base on the renewable energy issues.

Here are some of the challenges we face when we try to develop renewable energy. Except for geothermal garbage, and bagasse sources, most of the other sources are not available 24 hours per day.

We know from experience that too much wind can cause problems to the electrical grid-- HELCO, our Big Island utility has to maintain system quality on the island.

On the neighbor islands, the issue of curtailment or turning off renewable facilities because the demand is low.

The other big challenge is COST. We have a responsibility to provide our customers with reliable electricity at the lowest reasonable cost and the current cost of some renewable technologies is still too high.

The maturity of the technologies also varies greatly -- ranging from the research stage to full fledged commercial availability.

As I mentioned before, we are supporting a lot of R&D projects that we hope will help bring down costs in the long run and speed up the maturity of these technologies.

The availability of land for large-scale renewable energy projects is also a challenge especially in Hawaii, where land is a premium commodity. And depending on where a site can be found, the need for long transmission lines to carry the power from remote sites to our existing system increases the costs.

And finally, there are environmental and cultural concerns associated with renewable energy technologies as well...Air quality and cultural concerns with geothermal...aesthetics and impact on birds for wind power...just to name a few.

Page 34

Renewable Energy Initiatives

- Renewable energy RD&D projects
- Sun Power for Schools Program extension
- Large-scale PV project
- Renewable energy webpage

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35

We will also negotiate with the Department of Defense for an agreement to use their Lualualei lands for a large-scale (in the order of 50 MW) photovoltaic installation. If it goes through, this installation would be phased-in over a number of years. Since PV costs are still high, we will work with our congressional delegation to get federal funding for this DOD project.

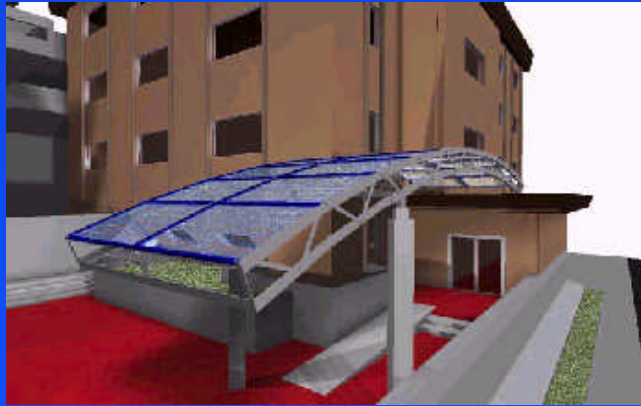
In addition, we will extend our Sun Power for Schools program for another 2 years to 2002. This program installs small photovoltaic systems at public high schools using monies voluntarily contributed by our customers over and above their electric bills. Since customer contributions have been small, we have heavily subsidized this program.

Although the program doesn't significantly increase the amount of renewables on the system, it does provide a good showcase for our renewable energy efforts.

We will also issue a Request for Proposal, or RFP, for renewable energy projects on Oahu. Let me discuss this more in detail.

Renewable Energy RD&D Projects

- Ward BIPV (entry shade)
- PV Bus Stops Shelters
- Large High Profile BIPV Project
- PV Rooftop Potential Assessment by UH SOA
- PV Parking Shade -- HELCO and MECO



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36

Sun Power for Schools Program

- **Sun Power for Schools Extension (2001 - 2002)**
 - PUC notified of extension
 - Department of Education and HECO signed agreement
 - Met with Department of Education personnel on future schools

Large Scale PV Project

- Land is a barrier to large-scale photovoltaic development
- Preserve a site for future utility-scale photovoltaic development
- Reduce oil use
- Promote renewable technology
- Photovoltaic costs are dropping¹
 - 1996-1997 average cost--\$9.77/watt
 - 1998-1999 average cost--\$8.46/watt

¹ Source: UPVG report, Oct. 2000

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38

PVEP involves the phased development of a utility-owned, multi-MW facility at West Loch to generate electricity from the sun

The PVEP would be built on military property based on the “overlay use” concept and would reserve lands for future HECO renewable energy development

Federal funds would be sought to increase the size of the first phase of PV arrays at the PV Energy Park, which is proposed for the 2002 timeframe

Future phases would be installed as additional funds are obtained and/or as the economics of PV improve

Pending State Legislation

- Supported net energy metering (similar to present California net energy metering)
- Supported renewable portfolio standards (goals without penalties)
- Supported solar tax credit extension to 2010
- Supported hydrogen research and development

Summary

- **HECO, HELCO and MECO have demonstrated a long-term commitment to RE and energy efficiency**
- **HECO, HELCO and MECO will continue to support RE and energy efficiency through a variety of programs, projects and partnerships**
- **We're helping to address the challenges to RE development in Hawaii**
- **Challenges exist for all large scale energy sources, renewable or conventional**
- **Partnerships can help**

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40

In summary.

We can be proud that Hawaii has a very good renewable energy track record as compared to the rest of the country.

But as hard as we work to reduce our dependence on oil in the electric area, we should all be aware that twice as much oil goes to transportation.

The Hawaiian Electric family has a strong record of using renewable energy resources and supporting projects to help further the development of these sources. This includes implementing a green pricing program to give our customers an opportunity to make voluntary contributions to renewable energy.

At the present time, we still have a number of challenges when it comes to utilizing renewable energy. These include 24-hour availability, cost, land availability, and environmental concerns...but we continue to support research and development projects to help address these issues...

and we are committed to buying power from renewable energy sources where their cost is equal to or below conventional sources.

Looking back on the past century, we have made great strides in developing renewable energy ...and in partnership with government and our customers, we're committed to increasing our use of renewable energy even further as we move into the new millennium.

Thank you.